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Smart home security system with fire emergency response

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ABSTRACT

A home security system with an immediate fire emergency response is needed to be installed in commercial buildings, apartments, malls and garage of independent houses. In the smart home security model where various factors such as intruders can be detected and an image is sent through e-mail using the SMTP protocol. If there are any vibrations above a certain threshold value which could be harmful, is sensed then an alert message is sent to the owner of the house using a cloud app Twilio. If the smoke is sensed and even fire detected, this system detects it and if the value is greater than the given threshold value it turns on the DC pump through which the water runs to the sprinkler attached to the end of the water pipes. Integration of both home security and fire response is aimed in this paper.

Keywords—

1. INTRODUCTION

Security and safety are a top concern and with continuous advancements happening, the security of one's home or building must not be left behind. Fire or gas leakage is an undesirable event that could bring a great loss to human life. While LPG is an essential need of every household, its leakage could lead to a disaster. To prevent these losses, various alarm systems have been developed such as smoke detectors, temperature sensor-based systems etc. As technologies evolve and to alert on LPG leakage or Fire and prevent any catastrophe there are various products to detect the leakage. In conjunction with the cheaper instruments, internet-based and wireless broadband technologies, have also improved and there are now various systems that enable cheap, high rate data transmission and wireless networking. PIR sensor will detect human appearance which will notify the user by sending the image captured by the camera through the mail. The Smoke and Gas detection system proposed, integrates the use of affordable instruments, connectivity and wireless communication. A Raspbian based Smoke and Gas detector alarm are developed here. If gas leakage occurs, this system detects it and sends an alert message and an e-mail to the owner of the building. If smoke is sensed, this system detects it and compares with the threshold value, through which the water runs to the sprinkler attached to the end of the water pipes and the message is also sent to the owner. If the value is more than the threshold it actuates the relay the DC pump.

2. OVERVIEW

This paper is divided into following sections: section III describes the block diagram, circuit diagram and development of the project; section IV describes the experimental results of the project, section VI describes the conclusion and further enhancements of the work.

3. DEVELOPMENT

3.1 Block Diagram of the proposed system

The system has single node/device platform that monitors the gas leakage level, smoke level, vibration level, flame detection, presence of an intruder will alert the user through a message and an email to the respective owner of the place.

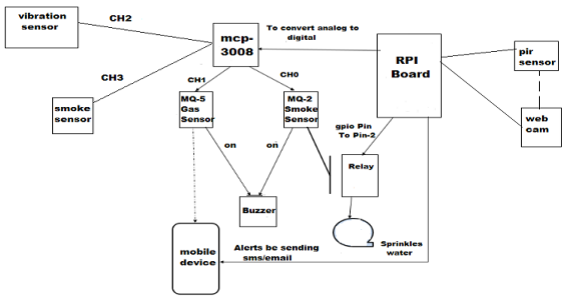

Fig 1: Block diagram of the proposed system

Overall block diagram of the model as shown in the figure 1. Different sensors are installed at a different location in the home.

The USB camera and PIR sensor are installed at the front door of the home interfaced with the Raspberry Pi. When there is an

intruder present, PIR sensor becomes high which captures the image of the intruder through the web-camera and sends an e-mail to the mail id of the respective owner of that place. The vibration sensor is integrated along with RPI to sense the undesirable sounds in the house above a certain threshold level and send an alert message to the respective owner of the house through a Twilio cloud application. The flame sensor is also used to sense unexpected fire incidents and send an alert message to the respective owner through the same cloud application. smoke sensor and the gas sensor is also integrated to this system as a fire emergency response system which senses the gas level and the smoke level above a certain threshold value which actuates the relay which in-turn turns on the DC pump, an alert message and an e-mail is sent to the owner.

A low cost 8 channel 10-bit precise analogue to a digital converter where each sensor is interfaced to different channels of the ADC to get their respective analogue values.

3.2 Circuit diagram of the proposed system

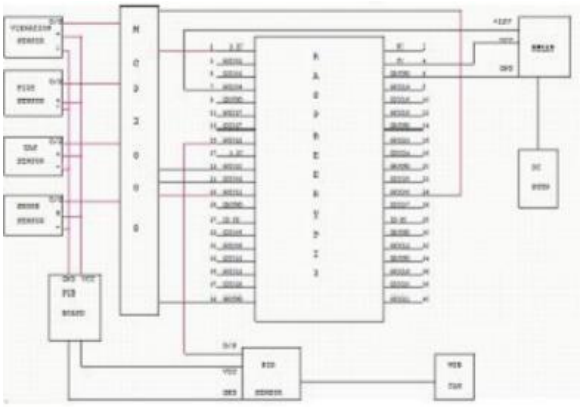

Fig. 2: Circuit diagram of the proposed system

The gas sensor, vibration sensor, flame sensor, smoke sensor and PIR sensor needs about 5 volts of power in order to operate, this is done by connecting 5 volts to VCC and connect all the sensors ground to any one of GND pins in RPI-3 board through a breadboard. The mcp3008 ADC needs about 3.3v to operate, an SCLK, ground and MISO/MSIO serial peripheral interface that is interfaced with the respective pins of the RPI.

The Output pin gives out the voltage reading, which is proportional to the amount of smoke, gas, vibration, flame that the sensor is exposed to. Again, a high voltage output means the sensor is exposed to LPG, flammable combustible gases, undesirable vibrations. A low voltage output means the sensor is exposed to either little or no parameters sensed. The output pin of the PIR sensor goes high when an intruder is sensed, which in turn makes the webcam connected to the USB port of the RPI to capture an image and send an email.

The output of the sensors goes into the MCP3008 pin CH0, CH1, CH2, CH3 of the MCP3008. This is one of the analogue input pins of the MCP3008. The MCP3008 needs to convert this analogue signal from the Smoke sensor, Gas sensor, vibration sensor, flame detection sensor into a digital signal, which is the only type of signal that the Raspberry Pi can interpret. The analogue values of the mcp3008 as a result of our experiment. The output of the relay is interfaced to any one of the GPIO pins of RPI which in turn actuates the relay and turns the dc pump.

4. RESULTS

The hardware components used for the system set up are a Raspberry Pi module, PIR, smoke sensor, vibration sensor, fire sensor, camera and dc pump actuated by a relay driver circuit are mounted as shown in figure 3.

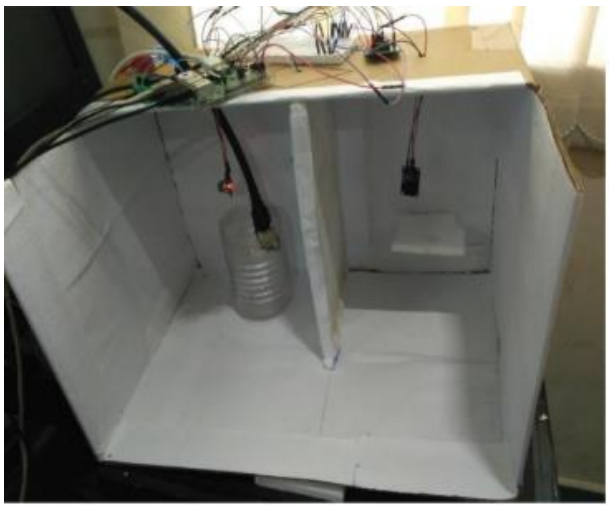

Fig. 3: Implementation of the proposed model

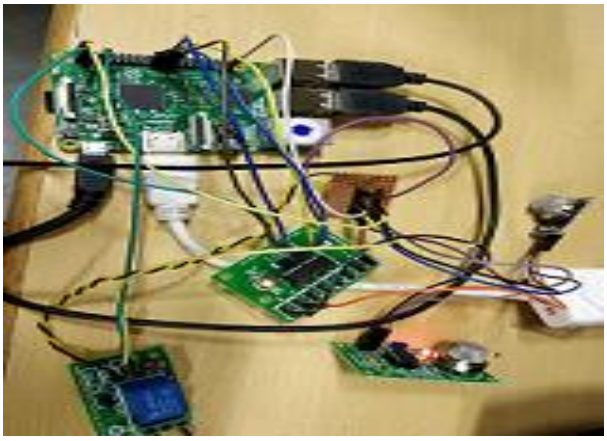

Fig. 4: Hardware description

Figure 3 shows the component placed in a house. The sensors are placed in different places in the house. PIR sensor is placed near the door. Smoke and fire sensors are placed in the kitchen. Vibration sensors are usually placed near the windows.

The output of the sensors which is in digital format is converted into analogue values using MCP3008 ADC is sent to the owner's mobile through a Twilio cloud application from the raspberry pi3. When an object moves within the range of PIR sensor, a signal is sent to the controller, which initiates the webcam snaps a photo which is stored onto the memory card of Raspberry Pi. The stored photo is then forwarded via email to the user. When the gas is above a certain threshold value, the led on the MQ2 gas sensor board turns on.

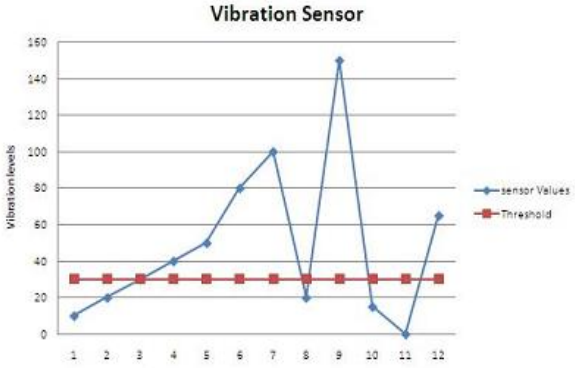

Fig. 4: Depicts the vibration level values for different samples of time with a threshold value of 30

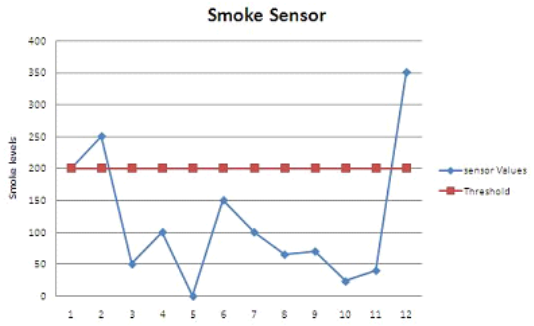

Fig. 5: Depicts the smoke level values for different samples of time with a threshold value of 200

Figure 4 and figure 5 depicts the vibration sensor and smoke sensor which senses certain values of vibrations and smoke levels respectively for different samples of time and are plotted against their respective level. When the vibration level, smoke level reaches beyond a certain threshold value an alert message is sent to the respective owner's mobile.

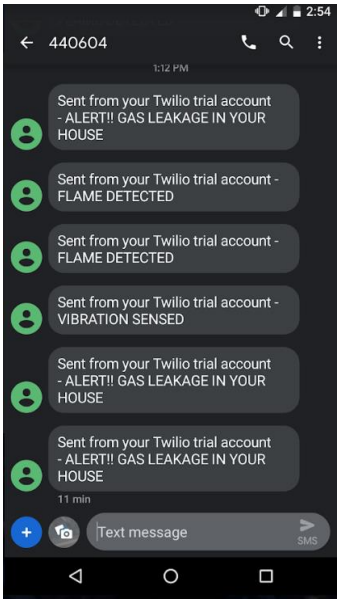

Fig. 6: Displays the different alert messages sent to the owner through the Twilio application

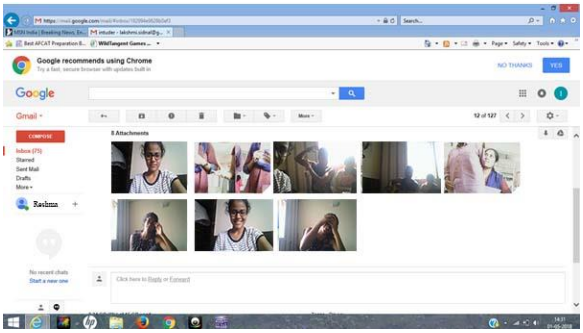

Fig. 7: Different snapshots of the intruder sent through email to the respective owner

Figure 7 shows the result of mobile through Email. The above snapshots were taken when there was a breach in the door, so the user can easily identify where exactly there is a breach in security. Messages, notifications, recipient email ID etc. were entered into the system through python scripts. The Raspberry Pi is programmed to operate as an alarm system in which it detects intrusion at entry points along with motion within the home and where email alerts can be sent with pictures to allow real-time monitoring of the home. Raspberry Pi features include Wi-Fi wireless technologies and this is the shortcut to display images directly on email

5. CONCLUSION AND FURTHER ENHANCEMENTS

This paper presents the design and implementation of a low cost but secure home security system for general users. The security level is increased due to the usage of Raspberry Pi which sends the images to the user, has inbuilt capabilities and is easily connectable to external devices. Raspberry pi proves to be a smart, economical and efficient platform for implementing the home security system. Two advantages provided by the system is that Necessary action can be taken in short span of time in the case of the emergency condition and design of a breadboard/PCB board which is also small in size. Reduced size makes it more applicable for commercial manufacturing and distribution. A raspberry pi and open source applications with its ever-growing community and development provide great hope in the near future. The currently proposed system is using MQ-2 and MQ-5 sensors to detect Gas and Smoke differently. This Smoke and Gas detection system is a real-time monitoring system that detects the presence of smoke in the air due to fire or leakage of gas in the house. Also, when smoke is detected, the Raspberry Pi board activates DC pump and water is sprinkled through water sprinkler placed at the end of the water pipes. As the level of smoke decreases the pump is turned off, the water sprinkler stops and the message is sent to the respective owner.

For further Enhancement, we can integrate both gas and smoke module into one sensor. Therefore, both smoke and gas will be detected by one same sensor. Here this system detects fire danger with the help of smoke, but in future, we can enhance the system to detect the fire itself.

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